Keith D. Morrison

Curriculum Vita

Lawrence Livermore National Laboratory
Biosciences and Biotechnology Division
Nuclear and Chemical Sciences Division

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CAREER PROFILE

I am broadly interested in interdisciplinary studies of mineral, organic and microbe interactions. My PhD research has focused on studying the antibacterial activity of minerals and generation of reactive oxygen species. My long term career goals are focused on interdisciplinary studies of minerals in the environment, which will bring together experts in geology, microbiology, organic chemistry and biochemistry to creatively solve global environmental health problems.

EDUCATION

PhD, Geology (Biogeochemistry), December 2015*, Arizona State University*

MS, Geology (Clay Mineralogy), May 2010, *University of California Riverside*

BS, Environmental Sciences (Toxicology), June 2007, *University of California Riverside*

RESEARCH EXPERIENCE

Lawrence Livermore National Laboratory 12/2015 – Present
Postdoctoral Scholar

- Uranium phosphate biomineralization via *Caulobacter Crescentus*
- Capillary X-ray diffraction (XRD) and mineral identification
- Plutonium hydroxamate ligand stability and redox
- Gas chromatography mass spectroscopy (GC-MS) of Pu-hydroxamate oxidation/hydrolysis

Arizona State University 9/2010 – 12/2015
Graduate Research Assistant

- Characterizing antibacterial mineral zones in a natural clay deposit
- Quantitative mineralogy using X-ray diffraction
- Geochemistry of pyrite oxidation and reactive oxygen species
- Geochemical modeling of metal speciation and mineral stability fields
- Microbiology; metal toxicity and genetic stress responses
- Bioimaging of antibacterial minerals and bacteria
- Scanning transmission X-ray microscopy (STXM) at the Advanced Light Source, Berkeley CA
- Scanning Transmission Electron Microscopy-Electron Energy Loss Spectroscopy
- Nano Secondary Ion Mass Spectrometry (NanoSIMS)

USGS Boulder Colorado 6/2010 - 8/2010
Lab Assistant

- Worked in conjunction with a team of scientists on the 5th Reynolds Cup quantitative mineralogy competition (2nd place)
- Quantitative XRD using RockJock, XRF elemental analysis

University of California Riverside 9/2007 - 6/2010
Graduate Student Researcher

- Performed geopolymerization reactions catalyzed by the structural iron in clay minerals
- Discovered selective iron reduction in ferruginous smectite by the amino acid cysteine
- Mastered FTIR, XRD and chemical techniques used in clay mineralogy

University of California Riverside 1/2006 - 6/2007
Lab Assistant

- Worked in conjunction with a team of scientists on ODP (ocean drilling project) samples
- Independently maintained and calibrated lab equipment

TEACHING EXPERIENCE

- University of California Riverside: Oceanography (2007-2009)
- University of California Riverside: Minerals and Human Health (2010)
- Arizona State University: Dangerous World (2012)

LABORATORY EXPERTISE

Quantitative X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), Scanning Transmission X-ray Microscopy (STXM), Scanning Transmission Electron Microscopy-Electron Energy Loss Spectroscopy (STEM-EELS), Nano Secondary Ion Mass Spectrometry (NanoSIMS), Inductively coupled plasma mass spectrometry (ICP-MS) sample preparation, Gas chromatography mass spectrometry (GC-MS), Reactive oxygen species assays, Microbiology techniques, Bacterial membrane isolation, 2D gel electrophoresis, Western blot protein analysis, LacZ genetic fusions, Protein carbonylation and lipid peroxidation assays, Fluorescence spectroscopy and bacterial efflux probes.

PUBLICATIONS

Morrison KD, Misra R and Williams LB (2016). Unearthing the antibacterial mechanism of medicinal clay: A geochemical approach to combating antibiotic resistance. *Sci. Rep.* **6**, 19043; doi: 10.1038/srep19043.

Soparkar K, Kinana AD, Weeks JW, Morrison KD, Nikaido H and Misra R (2015). Reversal of the drug binding pocket defects of the AcrB multidrug efflux pump protein of Escherichia coli. *Journal of Bacteriology*. doi:10.1128/JB.00547-15.

Misra R, Morrison KD, Cho HJ and Khuu T (2015). Importance of real-time assays to distinguish multidrug efflux pump-inhibition and outer membrane-destabilizing activities in *Escherichia coli. Journal of Bacteriology*. 197:2479-2488.

Morrison KD, Underwood JC, Metge DW, Eberl DD and Williams LB (2014). Mineralogical variables that control the antibacterial effectiveness of a natural clay deposit: *Environmental Geochemistry and Health*. 36:613-631.

Morrison KD, Bristow TF and Kennedy MJ (2013). The reduction of structural iron in ferruginous smectite via the amino acid cysteine: Implications for an electron shuttling compound: *Geochim. Cosmochim.* Aca. 106:152-163.

Bristow TF, Kennedy MJ, Morrison KD and Mrofka DD (2012). The influence of authigenic clay formation on the mineralogy and stable isotopic record of lacustrine carbonates: *Geochim. Cosmochim.* Aca. 90:64-82.

PRESENTATIONS

Boggs MA, Jiao Y, Dai ZR, Morrison KD, Zavarin M and Kersting AB. The effect of natural organic matter on actinide redox transformations and sorption reactions, (2016 Environmental System Science PI meeting, Potomac MD).

Morrison KD and Williams LB. Unearthing the antibacterial activity of medicinal clays. (2015 Presentation, Euroclay Edinburgh).

Morrison KD and Williams LB. Unearthing the antibacterial activity of medicinal clays. (2015 Presentation, 27th International Applied Geochemical Symposium).

Morrison KD and Williams LB. The antibacterial activity of minerals provides new insights on metal toxicity. (2014 Presentation, 51st Annual Meeting of the Clay Minerals Society).

Morrison KD, Williams LB and Misra R. The antibacterial activity of minerals provides new insights on metal toxicity. (2014 Presentation, 53rd Annual American Society of Microbiology AZ/NV Branch Meeting).

Morrison KD and Williams LW. Antibacterial minerals: Establishing an antibacterial mechanism. (2013 Presentation, MedGeo 5th International Conference on Medical Geology).

Morrison KD and Williams LB. Interactions between antibacterial clay minerals and bacteria: Mapping transition metal speciation using scanning transmission X-ray microscopy: (2012 Poster, Advanced Light Source Users Meeting).

Morrison KD and Williams LB. Interactions between antibacterial clays and bacteria: Determining the reactivity and geochemistry of transition metals. (2012 Presentation, 49th Annual Meeting of the Clay Minerals Society).

Morrison KD and Williams LB. Interactions between antibacterial clays and bacteria: Determining the reactivity and geochemistry of transition metals: (2012 Presentation, 9th Annual Southern California Geobiology Symposium).

Morrison KD, Eberl DD, Metge DW, Underwood JC and Williams LB. Antimicrobial clay mineral deposits and Fe(II) exchanged smectite. (2010 Presentation, Geological Society of America Annual Meeting).

Morrison KD, Kennedy MJ and Bristow TF. The reduction of structural iron in ferruginous smectite via the amino acid cysteine. (2010 Presentation, 7th Annual Southern California Geobiology Symposium).

Morrison K., Kennedy MJ and Bristow TF. Geopolymerization of organic matter via reduction of structural iron (III) in 2:1 expandable clay minerals. (2009 Presentation, Clay Minerals Society conference).

Bristow TF and Morrison KD. Cyclical trends in clay mineralogy of the green river formation. (2009 Poster, Clay Minerals Society conference).

Morrison KD, Kennedy MJ and Bristow TF. Mechanistic control of organic matter preservation governed by mineral surface area in laboratory and natural samples from the eocene green river formation. (2008 Presentation, Geological Society of America Joint Annual Meeting).

AWARDS AND GRANTS

Recipient of the Achievement Reward for College Scientists (ARCS) Scholarship for graduate research. ($7,000) (2013-2015):
https://www.arcsfoundation.org/phoenix/news/arcs-phoenix-asu-scholar-keith-morrison-publishes-paper-antibacterial-effectiveness-natural-cla

https://www.arcsfoundation.org/phoenix/gallery/arcs-phoenix-proudly-presents-our-2013-2014-scholars

2nd Place Presentation at the 51st Annual Clay Minerals Society Meeting. Session chair; clays, nanoparticles and health. (2014):
http://www.clays.org/SOCIETY%20AWARDS/StudentAwards.html

1st Place Presentation at the MedGeo 5th International Conference on Medical Geology (2013)

Graduate & Professional Student Association (ASU) Travel Grant ($950) (2012)

1st Place Presentation at the 49th Annual Clay Minerals Society Meeting (2012):
http://www.elementsmagazine.org/archives/e8_5/e8_5_sn_clays.pdf

Clay Minerals Society travel grant in the amount of $1,000 (2012)

Beam time allocated at the Advanced Light Source, Berkeley CA, (11.0.2 STXM Molecular Environmental Science Beam line, 56 hours, 2011) (5.3.2.2 STXM, 24 hours, 2012)

Clay Minerals Society research grant and Robert J. Reynolds, Jr. Research Award for research on antibacterial clays ($2,000) (2011)

Geological Society of America research grant providing funding for STXM analysis of antibacterial clays and bacteria ($3,000) (2011 and 2014)

2nd Place in the 5th Reynolds Cup Quantitative Mineralogy Competition (Team lead by Dennis Eberl) (2010)

PROFESSIONAL MEMBERSHIPS/AFFILIATIONS

Member, Geological Society of America (GSA), 2008-present

Member, Clay Minerals Society (CMS), 2009-present

Member, International Medical Geology Association (IMGA), 2013-present

Member, American Society for Microbiology (ASM), 2014-present